REMARKS

Claims 1 – 32 are now pending in the application. The Examiner is respectfully requested to reconsider and withdraw the rejections in view of the amendments and remarks contained herein.

Rejection Under 35 U.S.C. § 102

Claims 1 – 8, 10, 12 – 16, 18, 20 – 25, 27, 29 and 30 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Boverie et al. (U.S. Pat. No. 5,349,932). This rejection is respectfully traversed.

Claim 1 includes determining a shaped torque command based on a torque command generated by an input device, calculating an actuator variable based on the shaped torque command and a gain and regulating an actuator based on the actuator variable to adjust the torque output. Boverie et al. fails to teach or suggest determining a shaped torque command based on a torque command generated by an input device, calculating an actuator variable based on the shaped torque command and a gain and regulating an actuator based on the actuator variable to adjust the torque output.

The present invention provides a torque-based control system that controls engine torque using available actuators including, but not limited to, throttle, spark and fuel. A torque command is generated by an input device (e.g., accelerator pedal) and a shaped torque command is determined based on the torque command. An actuator variable (e.g., throttle position, spark timing, fueling rate) is calculated based on the shaped torque command and a gain. The actuator is regulated based on the actuator variable to adjust the torque output of the engine. In this manner, the present invention

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provides a feed-forward system that regulates the actuator to achieve the torque command.

Boverie et al. discloses a throttle-based control system that regulates the air-to-fuel (A/F) ratio of an engine based on an indicated set point (θ) of an accelerator pedal. More specifically, a set-point air charge (R_c) is determined based on θ and a reference air charge (R_r) is determined from a behavioral model of the engine based on R_c. A throttle valve opening (φ) is determined based on the difference between R_c and a measured air charge (R_m). (Col. 2, Lines 3 – 22). The system disclosed in Boverie et al. constrains the air entering the engine based on the behavioral model of the engine to control the A/F ratio (Col. 2, Lines 23 – 26). In this manner, Boverie et al. provides a feedback system that reacts to the error between R_c and R_m, whereby φ is regulated to chase R_r.

Therefore, Boverie et al. fails to teach or suggest a torque-based system that regulates an actuator based on a shaped torque command that is determined from a torque command. Accordingly, reconsideration and withdrawal of the rejection are respectfully requested.

With regard to claims 2 – 8, 10 and 11, Applicants note that each ultimately depends from claim 1, which defines over the prior art, as discussed in detail above. Therefore, for at least the reasons stated above with respect to claim 1, claims 2 – 8, 10 and 11 also define over the prior art and reconsideration and withdrawal of the rejections are respectfully requested.

Claim 12 has been amended herein to include determining a desired air-per-cylinder (APC) based on a torque command, calculating an effective throttle area based

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on the desired APC and an inverted dynamic model of the engine and regulating a throttle to provide the effective throttle area. Claim 20 has been similarly amended to include a controller that determines a desired air-per-cylinder (APC) based on a torque command, that calculates an effective throttle area based on the desired APC and an inverted dynamic model of the engine and that regulates a throttle to provide the effective throttle area.

Boverie et al. fails to teach or suggest determining a desired air-per-cylinder (APC) based on a torque command, calculating an effective throttle area based on the desired APC and an inverted dynamic model of the engine and regulating a throttle to provide the effective throttle area. As discussed in detail above, Boverie et al. discloses a throttle-based control system that regulates the air-to-fuel (A/F) ratio of an engine based on an indicated set point (θ) of an accelerator pedal. A throttle valve opening (φ) is corrected based on the difference between R_c and a measured air charge (R_m). More specifically, Boverie et al. provides a feedback system that reacts to the error between R_c and R_m, whereby φ is regulated to chase R_r. R_r is determined based on a the difference between a fed-back R_r and R_c using a behavioral model of the engine (see Figure 4 and Col. 6, Lines 8 – 11).

Therefore, Boverie et al. fails to teach or suggest calculating an effective throttle area based on the desired APC and an inverted dynamic model of the engine and reconsideration and withdrawal of the rejections are respectfully requested.

With regard to claims 13 – 16, 18, 21 – 25 and 27 Applicants note that each ultimately depends from one of claims 12 and 20, which defines over the prior art, as discussed in detail above. Therefore, for at least the reasons stated above with respect

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to claims 12 and 20, claims 13 – 16, 18, 21 – 25 and 27 also define over the prior art and reconsideration and withdrawal of the rejections are respectfully requested.

Claim 29 includes calculating a desired mass airflow out of an intake manifold based on a desired APC, determining a desired mass airflow into the intake manifold based on the desired mass airflow out of the intake manifold, calculating an effective throttle area based on the desired mass airflow into the intake manifold and regulating the throttle to provide the effective throttle area. Boverie et al. fails to teach or suggest calculating a desired mass airflow out of an intake manifold based on a desired APC, determining a desired mass airflow into the intake manifold based on the desired mass airflow out of the intake manifold, calculating an effective throttle area based on the desired mass airflow into the intake manifold and regulating the throttle to provide the effective throttle area.

As discussed in detail above, Boverie et al. discloses a throttle-based control system that regulates the air-to-fuel (A/F) ratio of an engine based on an indicated set point (θ) of an accelerator pedal. A throttle valve opening (φ) is corrected based on the difference between R_c and a measured air charge (R_m). More specifically, Boverie et al. provides a feedback system that reacts to the error between R_c and R_m, whereby φ is regulated to chase R_r. R_r is determined based on a the difference between a fed-back R_r and R_c using a behavioral model of the engine (see Figure 4 and Col. 6, Lines 8 – 11). Boverie et al. does not consider mass air flow into and/or out of the intake manifold (i.e., intake dynamics).

Accordingly, Boverie et al. fails to teach or suggest calculating a desired mass airflow out of an intake manifold based on a desired APC, determining a desired mass

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airflow into the intake manifold based on the desired mass airflow out of the intake manifold, calculating an effective throttle area based on the desired mass airflow into the intake manifold and regulating the throttle to provide the effective throttle area, and reconsideration and withdrawal of the rejection are respectfully requested.

Claim 30 ultimately depends from claim 29, which defines over the prior art, as discussed in detail above. Therefore, for at least the reasons stated above with respect to claim 20, claim 30 also defines over the prior art and reconsideration and withdrawal of the rejections are respectfully requested.

Claims 1 – 8, 10 – 16, 18 – 25, 27 – 30 and 32 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Southern et al. (U.S. Pat. No. 5,606,951). This rejection is respectfully traversed.

Claim 1 includes determining a shaped torque command based on a torque command generated by an input device, calculating an actuator variable based on the shaped torque command and a gain and regulating an actuator based on the actuator variable to adjust the torque output. Southern et al. fails to teach or suggest determining a shaped torque command based on a torque command generated by an input device, calculating an actuator variable based on the shaped torque command and a gain and regulating an actuator based on the actuator variable to adjust the torque output.

Southern et al. discloses a system for controlling the air supply to an engine. The system determines an initial coarse setting (S0) for the throttle position from a look-up table based on a pedal position and engine speed. The actual position of the throttle valve (12) is compared to S0 (i.e., desired setting) and is adjusted based on the

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difference or error therebetween (see Col. 6, Lines 23 – 39). Because S0 is determined from a look-up table for a given pedal position and engine speed, S0 is controlled on a steady-state basis and is not dynamically controlled. Southern et al. does not determine a torque shaped torque command based on a torque command generated by an input device. Therefore, reconsideration and withdrawal of the rejection are respectfully requested.

With regard to claims 2 – 8, 10 and 11, Applicants note that each ultimately depends from claim 1, which defines over the prior art, as discussed in detail above. Therefore, for at least the reasons stated above with respect to claim 1, claims 2 – 8, 10 and 11 also define over the prior art and reconsideration and withdrawal of the rejections are respectfully requested.

Claim 12 has been amended herein to include determining a desired air-per-cylinder (APC) based on a torque command, calculating an effective throttle area based on the desired APC and an inverted dynamic model of the engine and regulating a throttle to provide the effective throttle area. Claim 20 has been similarly amended to include a controller that determines a desired air-per-cylinder (APC) based on a torque command, that calculates an effective throttle area based on the desired APC and an inverted dynamic model of the engine and that regulates a throttle to provide the effective throttle area.

Southern et al. fails to teach or suggest determining a desired air-per-cylinder (APC) based on a torque command, calculating an effective throttle area based on the desired APC and an inverted dynamic model of the engine and regulating a throttle to provide the effective throttle area. As discussed in detail above, Southern et al.

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discloses a system for controlling the air supply to an engine. The system determines an initial coarse setting (S0) for the throttle position from a look-up table based on a pedal position and engine speed. The actual position of the throttle valve (12) is compared to S0 (i.e., desired setting) and is adjusted based on the difference or error therebetween (see Col. 6, Lines 23 – 39).

Southern et al. determines a required fuel per cylinder (FPC) and determines the desired air per cycle (APC) based on the FPC (Col. 5, Lines 14 – 18 and Col. 6, Lines 30 – 32) and does not determine APC based on a torque command. Further, Southern et al. does not determine throttle area based on APC and an inverted dynamic model of the engine. Instead, Southern et al. determines the throttle position from a look-up table based on a pedal position and engine speed. Accordingly, reconsideration and withdrawal of the rejections are respectfully requested.

With regard to claims 13 – 16, 18, 21 – 25, 27 and 28 Applicants note that each ultimately depends from one of claims 12 and 20, which defines over the prior art, as discussed in detail above. Therefore, for at least the reasons stated above with respect to claims 12 and 20, claims 13 – 16, 18, 21 – 25, 27 and 28 also define over the prior art and reconsideration and withdrawal of the rejections are respectfully requested.

Claim 29 includes calculating a desired mass airflow out of an intake manifold based on a desired APC, determining a desired mass airflow into the intake manifold based on the desired mass airflow out of the intake manifold, calculating an effective throttle area based on the desired mass airflow into the intake manifold and regulating the throttle to provide the effective throttle area. Souther et al. fails to teach or suggest calculating a desired mass airflow out of an intake manifold based on a desired APC,

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determining a desired mass airflow into the intake manifold based on the desired mass airflow out of the intake manifold, calculating an effective throttle area based on the desired mass airflow into the intake manifold and regulating the throttle to provide the effective throttle area.

As discussed in detail above, Southern et al. discloses a system for controlling the air supply to an engine. The system determines an initial coarse setting (S0) for the throttle position from a look-up table based on a pedal position and engine speed. The actual position of the throttle valve (12) is compared to S0 (i.e., desired setting) and is adjusted based on the difference or error therebetween (see Col. 6, Lines 23 – 39). Southern et al. determines a required fuel per cylinder (FPC) and determines the desired air per cycle (APC) based on the FPC (Col. 5, Lines 14 – 18 and Col. 6, Lines 30 – 32). Southern et al. does not teach or suggest calculating a desired mass airflow out of an intake manifold based on a desired APC or determining a desired mass airflow into the intake manifold based on the desired mass airflow out of the intake manifold. Therefore, reconsideration and withdrawal of the rejections are respectfully requested.

With regard to claims 30 and 32 Applicants note that each ultimately depends from claim 29, which defines over the prior art, as discussed in detail above. Therefore, for at least the reasons stated above with respect to claim 29, claims 30 and 32 also define over the prior art and reconsideration and withdrawal of the rejections are respectfully requested.

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REJECTION UNDER 35 U.S.C. § 103

Claims 11, 19, 28 and 32 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Boverie et al. (U.S. Pat. No. 5,349,932) in view of Southern et al. (U.S. Pat. No. 5,606,951). This rejection is respectfully traversed.

Each of claims 11, 19, 28 and 32 ultimately depend from one of claims 1, 12, 20 and 29, which define over the prior art, as discussed in detail above. Therefore, claims 11, 19, 28 and 32 also define over the prior art for at least the reasons stated above with respect to claims 1, 12, 20 and 29. Therefore, reconsideration and withdrawal of the rejections are respectfully requested.

ALLOWABLE SUBJECT MATTER

The Examiner states that claims 9, 17, 26 and 31 would be allowable if rewritten in independent form. Although Applicants thank the Examiner for recognizing the allowable subject-matter of claims 9, 17, 26 and 31, Applicants have presently refrained from rewriting any of claims 9, 17, 26 and 31 in independent form in view of the above discussion.

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CONCLUSION

It is believed that all of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider and withdraw all presently outstanding rejections. It is believed that a full and complete response has been made to the outstanding Office Action, and as such, the present application is in condition for allowance. Thus, prompt and favorable consideration of this amendment is respectfully requested. If the Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (313) 665-4969.

If for some reason a fee needs to be paid as well as one-month extension fee please charge Deposit Account No. 07-0960 for the fees, which may be due.

Respectfully submitted,

Dated: 12-15-04

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